# Volume-Efficient Momentum-exchange Actuator

Completed Technology Project (2015 - 2017)

## Project Introduction

The primary objective of this effort is to increase the robustness of a new momentum exchange actuator for attitude control of CubeSats. The new actuator boasts a reduced volumetric footprint and increased momentum storage capacity as compared to current reaction wheel concepts for small spacecraft. The focus of this effort is to bring our current breadboard-like prototype to environmental tests such as thermal cycling, vibrations, and vacuum tests.

The Volume-Efficient Momentum Exchange Actuator,  is a compactly packaged attitude control actuator designed for small spacecraft. Specifically, the actuator is intended for integration with CubeSat structures. Curren small-spacecraft reaction wheels can use up a full 10 cubic centimeter volume to provide a 3-axis solution while packaging constraints lead to a small momentum-storage-to-volume ratio. This project intends to increase the TRL of the new momentum actuator to provide a viable volume-saving alternative for attitude control of CubeSats.

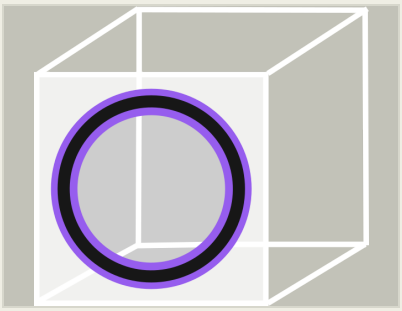
## Anticipated Benefits

Due to the cost benefits of small spacecraft, NASA is exploring the use of CubeSats as science platforms. The viability of CubeSat missions requires miniaturization of science instruments and spacecraft hardware. The concept can double the momentum capabilities of CubeSats, simplify spacecraft assembly, and, more importantly, expand the volume for science payloads.

Missions such as a follow on to GSFC's Dellingr, as well as multiple recently proposed science missions for the study of gravitational waves, heliophysics, and others would benefit from the expanded volume and momentum capacity of the actuator.

Technology development for small spacecraft has attracted increased interest over the past decade.  However, the development of attitude control system (ACS) actuators and sensors has focused on miniaturization of large-spacecraft technologies.  Although these scaled-down designs are effective they lack the performance and usability of their larger siblings. It is evident that new actuator and sensor concepts are required to improve the footprint and performance of ACS hardware for small spacecraft.

Current cubesat reaction wheel manufacturers can license our technology to develop single-axis actuators as well as integrated ACS packages that have higher performance and occupy a smaller volume than current offerings.



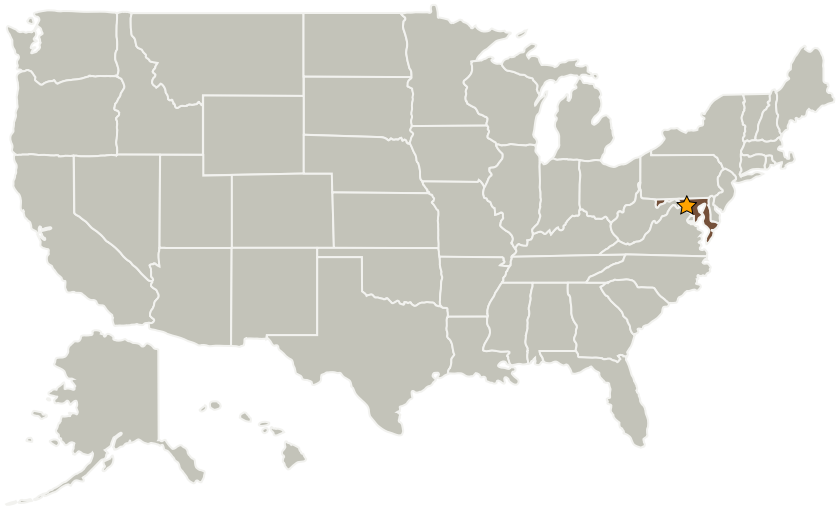
Volume-efficient Momentum Exchange Actuator

## Table of Contents

# Volume-Efficient Momentum-exchange Actuator

Completed Technology Project (2015 - 2017)

## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Goddard Space Flight Center(GSFC) | Lead Organization | NASA Center | Greenbelt, Maryland |

| Primary U.S. Work Locations |
|---|
| Maryland |

## Project Transitions

**October 2015:** Project Start

## Organizational Responsibility

**Responsible Mission Directorate:**

Mission Support Directorate (MSD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Center Independent Research & Development: GSFC IRAD

## Project Management

**Program Manager:**

Peter M Hughes

**Project Managers:**

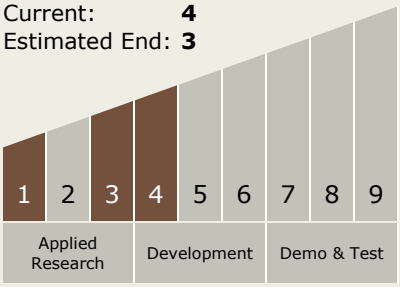
Jason W Mitchell
Michael A Johnson

**Principal Investigator:**

Gerardo E Cruz-ortiz

## Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **3**



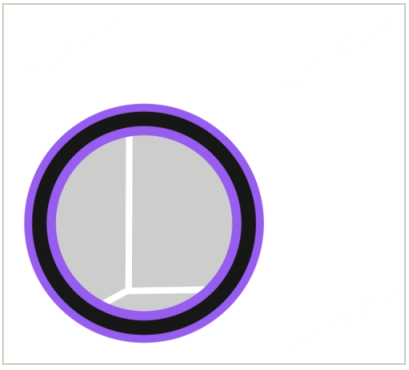
# Volume-Efficient Momentum-exchange Actuator

Completed Technology Project (2015 - 2017)

**September 2017:** Closed out

**Closeout Summary:** The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services.Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry.The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies.If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

## Images



**Logo**
Volume-efficient Momentum Exchange Actuator
*(https://techport.nasa.gov/image/19263)*

## Links

1438820813
*(no url provided)*

## Technology Areas

**Primary:**

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.3 Control Technologies
    - TX17.3.4 Control Force/Torque Actuators

## Target Destinations

Earth, Foundational Knowledge

# Volume-Efficient Momentum-exchange Actuator

Completed Technology Project (2015 - 2017)

## Project Website:

http://aetd.gsfc.nasa.gov/